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## Human control of climate: introducing cities

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## Introduction

In this commentary we present a new train of thought that combines two contrarian geohistorical theses, both highly controversial, but when merged create a compelling narrative that has contemporary resonance. The two arguments are Ruddiman's (2003, 2010, 2013) early anthropogenic thesis in which human impact on climate is pushed back before industrialization by thousands of years and Jacobs' (1969; Soja 2000, 2010; Taylor 2012a, 2013, 2014) cities first thesis in which cities are linked to agricultural beginnings and thereby their presence is also pushed back thousands years.

The reason our multi-millennium narrative is relevant to current climate change interventions is because it points towards moving international debate from focus on territorial carbon accounting, with concomitant local place interventions since Rio 1992, to collective lifestyle choices as the fundamental issue of concern. However, our geohistorical approach to changing ways of living departs from macro-economic proposals for a sustainable world, such as 'prosperity without growth' (Jackson 2009) and 'steady-state economy' (Daly 1991), by encompassing growth over stasis – past, present and future - through urban development. The worldwide contemporary preference for high levels of material consumption, both actual and aspired to, is the toxic core of current anthropogenic climate change; this is, we argue, essentially an urban process, a product of shared city developments. It is not simply that cities generate demand due to their demographic size; cities are themselves demanding because of their nature as dynamic engines of development with extensive trans-territorial

effects. We present a geohistorical narrative showing that this toxicity is not inevitable.

The critical urban dimension of consumption is not adequately appreciated in the dominant global conversation on responses to climate change, to be continued in Paris in December: mitigation has typically focused on technological 'solutions' in 'developed countries', whilst adaption has commonly focused on local small scale responses, largely in rural situations in 'developing countries'. Our argument is that the sum of these policy 'parts' - local mitigations and adaptations - can never be equal to the 'whole' need - changing worldwide global addiction to excessive consumption. Policy will have to address the collective demand of cities by delivering outcomes that promote sustainable urban lifestyles. In fact, traditional mitigation and adaptation strategies are not just lacking in necessary policy outcomes, they may themselves become part of the problem. Promoting practices to generate 'resilient cities' (Vale and Campanella 2005) is to encourage a 'bounce-back' from crisis that returns to current urban consumption. An alternative policy framework focuses on new ways of living; our narrative foresees a 'bounce-forward' movement to a very different kind of city (O'Brien and O'Keefe 2014). This is a process in keeping with Jacobs' (1969) theory of city development where innovation and improvisation are harnessed, which we argue can meet different needs to those generating contemporary excessive consumption.

The initial stimulus for constructing a new narrative for anthropogenic climate change is a simple coincidence between Ruddiman's and Jacobs' multi-

millennium theses. For Ruddiman human impact on production of greenhouse gases starts 8,000 years ago with carbon dioxide increases, is augmented 5,000 years ago with methane increases – both constitute the early anthropogenic impact - before the massive greenhouse gas increases of the last two hundred years. Drawing on Jacobs' cities first thesis, Soja (2000) identifies three urban revolutions: the first about 8,000 years ago comprising the origins of urbanization represented by Jericho and Catalhöyük; the second about 5,000 years ago is the familiar Mesopotamian urban revolution (traditionally 'the first cities'); and the third is the massive urbanization of the last 200 years associated with industrialization. The matching of the temporalities is quite unambiguous but this does not necessarily translate into connections between them. That is the purpose of this commentary, to draw the connections and thereby point towards the need for a fourth urban revolution.

### **Combining Ruddiman's and Jacobs' theses**

Ruddiman's (2010) basic method is to show how the Earth's climate varies over the long term – what he calls "nature in control" – and then to home in on change anomalies in the recent past, which he argues can only be explained as 'humans in control'. He attributes increased greenhouse gases, carbon dioxide and methane, to developments of agriculture across the world over the last ten thousand years. Specifically anthropogenic induced land cover change modified terrestrial ecosystems to such a degree that Ruddiman claims humans have controlled climate change over this long period before modern industrialization.. We argue that adding Jacobs' cities first thesis (i.e. before agriculture) firstly, supports Ruddiman's thesis, and re-orientates it so as secondly, to augment it by

providing an economic mechanism behind the essential social process of human expansion.

The initial response to the early anthropogenic climate change thesis was that there were simply too few people living in these early times to have made such an impact. This criticism has been countered in three main ways. First, the time effect: the impact of changing land cover has been compounded over a very long period – Ruddiman (2011, 5) uses the tortoise and hare as analogy for slow agricultural and rapid industrial influences. Second, the numbers of people involved in the rise of agriculture has been under-estimated – Gignoux et al (2011) show populations growths in double digits across different regions when agriculture appeared. Third, Boserup's (1965) thesis on the relationship between agricultural intensification with population growth is used to indicate that because earliest agriculture had least population pressure it produced initial very high per capita land cover changes (Ruddiman and Ellis 2009; Kaplan et al 2010). These arguments are brought together in Ruddiman's (2013) state-of-the-art summary of his thesis and we do not dispute them. Rather by bringing in Jacobs' cities first thesis we add a fourth counter to the idea that early peoples could not have affected global climate change. But this is not a simple addition; it provides an explanation for why and how agricultural begins and produces a common mechanism of social change capable of creating climate change for both of Ruddiman's impact eras, agricultural and industrial.

Jacobs' (1969) defines economic development as a special case of economic growth; the latter simply involves more work being done, development requires

new work to be done so that the division of labour is made more complex. Cities are the locales for such dynamic complex divisions of labour. This is because cities are knowledge-rich places of innovations and diffusions thereof due to their economic externalities: agglomeration externalities give rise to dense and intensive knowledges, connectivity externalities yield varied and extensive knowledges. Amongst the resulting new work that is created, Jacobs argues that import replacement is the key mechanism in development. In this process demand for a product previously satisfied through importing is produced locally enabling a shift in imports to other extra products. A spiral of new work growth from both new production and new import opportunities generates economic development. The link to Ruddiman's thesis is that for Jacobs, agriculture is a key import replacement for the earliest cities.

Embryonic cities derive from trade networks when production (new work) is added to trading hubs. With the consequent population growth, existing food procurement from hunter-gathering is unable to satisfy the increased demand: agriculture is invented to meet the shortfall. This is Jacobs' 'cities first thesis': cities emerge in the human story before farming. The traditional view of the very first cities appearing in Mesopotamia several millennia after the coming of agriculture is based on a supply theory of urban origins – cities only appear when agriculture has advanced enough to generate food surpluses to support urban life. To counter this conventional view the alternative demand theory simply asks why hunter-gatherers, whom Sahlins (2004) terms the first affluent society with few wants but much leisure, should choose to invent agriculture and the concomitant extra work (Taylor 2012a; 2013 102-13)). Jacobs' answer is that

there was no such rustic invention; agriculture is an early expression of the power of cities to mold their environs for their specific needs. Evidence for early cities across the world is briefly reviewed in Taylor (2013, 138-44). From an orthodox archaeological perspective these large settlements in 'wrong places at wrong times' cannot be locales for inventing agriculture and this has recently been debated (Smith et al 2014; Taylor 2015). However Jacobs' shift in interpretation of farming origins in no way lessens the importance of agriculture as Ruddiman envisages, rather it sets it in the new context of cities as crucibles of world-changing transformations (Taylor 2013).

The point we are developing here is not just the idea of farming not happening without urban demand, but that it is only through understanding the city economic development process that we can know the fundamental social mechanism behind human-induced climate change, one that applies to both its slow and rapid phases. Thus are cities the crucibles of world-changing transformation like agriculture, and why modern industrialization is associated with unprecedented levels of urbanization. Quite simply, cities are demanding: this way of thinking provides new plots for a fresh geohistorical narrative.

### **Introducing a geohistorical narrative for human control of climate**

Humans are different from all other species in having two means of social reproduction. All species harness the immediate resources of their environment thus creating a local dependence. The local can be a fixed territory or a moving supply area (seasonal path). Uniquely humans also draw on non-local resources, movement of goods to them from afar. Developed as trading, this is what makes



our species so environmentally dangerous: use of non-local resources breaks the local constraints of social reproduction; ultimately this provides the potential to exceed global capacity (Taylor 2012b). Evidence of trading can be found in early archaeological sites through geological origins of stone artifacts. However this remained small in scale for the vast majority of the time that humans remained hunter-gatherers (Gamble 2007). The problems of developing the necessary trust with strangers to enable routine trading kept the non-local contribution to social reproduction quantitatively unimportant (Graeber 2011). Overcoming this problem enabled the rise of cities.

Evidence of the earliest agriculture is about 12,000 years ago but Ruddiman (2010) shows its climatic impact only from 8,000 years ago. This time lag represents a slow transition, the first stirrings of urbanization, a stuttering into being of city networks with their new demands for food (Soja 2010). These initial networks are relatively fragile; overall growth is slow but by 8,000 years ago there is clear evidence of substantial urban settlements trading through complex divisions of labour as evidenced by Jericho and Catalhöyük (Jacobs 1969; Soja 2000, 2010,; Taylor 2012a, 2013). This is the breakthrough of the non-local becoming important in macro social change. It is this development of multiple vibrant city networks whose creation of new landscapes of agriculture instigates the rise of carbon dioxide that Ruddiman (2010) reports.

However, initially, the long-term resilience of early cities was problematic: surrounding agricultural supply becomes more distant as soils are exhausted finally creating empty quarters and lost cities (Taylor 2013). This problem is

solved 5,000 years ago with the Mesopotamian city network based upon sustainable irrigation agriculture. Similar urban develops were soon happening also in Chinese, South Asian and Egyptian riverine civilizations.

Table 1 shows the collective population of all cities with populations over 40,000 from 3300BC to AD1900 (Chandler 1989; Modelski 2003). Inputs for 40,000 people to eat, work and play requires a social reproduction logistics at a whole new scale, not to mention the outputs, both waste and exports. Importantly, such new scales of activity required new means of governance: the world-changing invention of states (Yoffee 2005), first as city-states and then empire-states incorporating multiple cities (Taylor 2012a, 2013). This new political dimension is vital to understanding the relatively slow rise of large cities to 1800. What is happening is that in traditional empires the city development process is replaced by plunder and tribute as the main means of wealth accumulation (Taylor 2013). The largest cities are now typically the imperial capitals that become huge consumption centres but otherwise there is a societal constraint on city development as new work: in all tribute empires, large and small, urban population never passes 10% of total population (Taylor 2013). However, both empires and their cities continued to grow and therefore overall the trend is a gradual increase in the collective large city population (Chase-Dunn and Manning 2002), which keeps Ruddiman's (2010) greenhouse gas anomalies moving forward.

This all changes in the transition to a modern world-system, dated from c. 1450 to 1650 (Wallerstein 2004), where the balance between political and economic

elites is readjusted in the latter's favour to create a more balanced power relation between cities and states (Taylor 2013). The result is a new release of urban economic development potential. However, at first this new world-system was not global, being focused mainly in Europe and the Americas. In 1800 Beijing, capital of a traditional empire, was still larger than London (Modelski 2003), but in the next century China is incorporated into the modern world-system, which becomes fully global by 1900. This is shown in the enormous increase in large city population reflecting a truly qualitative shift to new world of great cities as recognized at the time (Weber 1889).

This abrupt increase in large cities coincides with very rapid increases in greenhouse gases, generally taken to represent when humans have controlled climate change. But in this narrative instead of labeling the social change as just 'industrial' (Ruddiman 2010), the cities approach reinforces Brooke's (2014) thesis that the key environmental trigger is immensely heightened urban demand. This is when traditional bourgeois thrift is transformed into bourgeois conspicuous consumption making modern cities ultra-demanding. It is this toxic urban process, escalating through the twentieth century, that we have inherited today.

### **Present and future**

Our narrative began by identifying humans as a uniquely dangerous species; this potential is now being realized: it is not the simple landmark of urban population overtaking rural population that is important, but rather the increase and growth of larger and more demanding cities. We are currently moving towards the

ultimate non-local place: a global network society of urban consumption sinks. These are a vast variety of demanding urban economic developments with their myriad agglomerations and connections that are crucially implicated in stoking contemporary climate change (O'Brien and O'Keefe 2014).

Thus our call for a fourth urban revolution: it is our contention that what Glaeser (2011) calls humanity's greatest invention, cities, has to be reinvented. This goes far beyond current experiments in green city building; it is not about city as place, it requires thinking of cities as process. In this way it transcends Scott and Storper's (2014) distinction between 'issues in cities' and 'issues of cities'; our urban demand approach gels better with Brenner and Schmit's (2014) guidelines for understanding 'planetary urbanization' whilst keeping a local/non-local distinction. Jacobs' import replacing can be viewed as a continual mechanism of economic localization but one built upon continual urban innovation. Urban vibrancy without excessive consumption requires something akin to 'green networks of cities' (Taylor 2013b).

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**Table 1 Collective populations of large cities (40,000+), 3300BC to AD 1900**

<b>Dates</b>	<b>Pop. in 000s</b>
3300 BC	40
3000	40
2800	120
2500	190
2300	210
2000	120
1800	140
1500	110
1200	750
1000	420
800	425
600	800
400	3250
200	3732
AD 100	6149
400	5287
600	5313
800	6195
1000	7482
1200	5824
1400	7968
1600	11283
1800	12360
1900	133112